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Heavy Non-Ferrous Test Bars

We were a little surprised when, during an animated discussion on the nature of the test-bars best suited for use in connection with heavy non-ferrous alloys, a speaker strongly advocated the discarding of the separately-cast test-piece. Moreover, he seemed to find a reinforcement for his opinions when a later speaker recounted a case where separately-cast test-bars consistently passed the specification, whereas Tensometer test-pieces cut from the actual castings repeatedly and dismally failed. Surely, the reverse is the truth, for the fact that the test-bars gave satisfactory figures proved the only thing that they are designed to show, and that is that the alloy used was suitable from the angle of tensile strength. This leaves the mind free to concentrate on the balance of the factors capable of influencing mechanical strength, bearing in mind that not invariably does a well designed test-bar cast under scientifically-controlled conditions yield figures as high as the casting with which it is to be associated. Put simply, the investigation designed for the elucidation of the problem, where test-bars pass, and the castings fail, reduces itself to one of moulding and casting technique. In the case cited at the meeting, the use of a process involving the partial rotation of the mould whilst pouring in the metal had every appearance of effecting a cure. After hearing all the arguments, the audience, consisting almost entirely of non-ferrous founders handling the copper alloys, unanimously endorsed the lecturer's (Mr. W. A. Baker, B.Sc., of the British Non-Ferrous Metals Research Association) suggestion that the time was ripe for the creation of a new standard specification covering the making of test-bars for the bronze range of alloys. Moreoever, it was felt that the tentative specification recently published by the Canadian authorities and which we reproduced in our last issue, would form an excellent basis on which to work. For high shrinkage alloys, the keel bar was favoured, but because of the cost of machining and for other reasons, a second type should also be standardised for alloys not exhibiting this property to any marked degree. It is common experience, that a jobbing foundry initially undertaking service contracts demanding the submission of test-bars often finds it more difficult to produce a satisfactory bar than a presentable casting, but it is also established that once a reliable technique has been evolved, a sense of confidence results which enables the founder to reduce his waster bill to very reasonable proportions. The realisation of an ability invariably to produce a reliable test-bar is so impressed on the mind of the jobbing founder, that in his conversation he makes a mental division between the pre- and post-success period. We stress this because success has not always, or indeed usually, followed the same path or resulted in the same or even similar test-bars. One large London foundry, which for many years has been able not only to make excellent test-bars, but also build up an enviable reputation for the quality of its castings, has been kind enough to teach a number of smaller concerns its technique, thus forming one small group. Probably the same conditions, aided by the migration of staff, have occurred in other parts of the country. By and large, the situation is tolerable, but carries disadvantages. The satisfaction a foundryman feels through his skill in test-bar technique no doubt infects the regular service inspector, but when this man is transferred to another area and sees different methods being used, confidence in them is not immediately established. Until it is, the inspector may not be too popular! Though the introduction of the standards, such as are envisaged, will perhaps be an initial nuisance, it is certain that after a period of dual control by the old and new methods, they will confer immeasurable benefits on the industry as a whole.

Contents

Heavy Non-Ferrous Test-Bars, 87.—Correspondence, 88.—Coke Economies Resulting from Improved Cupola Control, 88.—Magnesium Foundry Technique, 89.—Specifications and the Need for Continued Research, 92.—Notes on Oil-Sand Practice in the Ordinary Foundry, 93.—Pattern Insurance, 96.—Wartime Foundry Raw Materials, 97.—Plaster for Chill Patterns, 99.—Hot Tear Formation in Steel Castings, 100.—New Carnegie-Illinois Electric Furnace, 102.—Foundry Fuel Conservation, 102.—News in Brief, 104.—New Patents, 106.—Personal, 106.—Company Results, 108.—Obituary, 108.—New Companies, 108.—New Trade Marks, 108.—Contracts Open, 108.—Raw Material Markets, 110.

CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

TEST BARS AND CASTINGS

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—It is not improbable that this letter will anticipate the publication in THE FOUNDRY TRADE JOURNAL of the report of the London Branch meeting of the Institute of British Foundrymen, held on January 22 at the Institution of Civil Engineers. Mr. Baker, of the British Non-Ferrous Research Association, presented a Paper on test-bars for non-ferrous alloys, with particular reference to manganese bronze.

The meeting followed very closely on the lines advocated in Mr. Baker's introductory remarks when he expressed the hope that following the presentation of his Paper, a discussion would ensue which would permit a lead being given to the adoption of a standard test-bar for non-ferrous alloy castings, excluding light alloys.

A mandate was subsequently given to the acting chairman, Mr. Frank Hudson, to take such action that would enable a standard test-bar for non-ferrous castings to be adopted that would satisfy any non-ferrous alloy casting..

The suggestions put forward at the meeting were not substantiated by data correlated as a result of a comprehensive research programme dealing with the relationship between test-bars and castings, but chiefly were based upon facts which, although excellent in themselves and in the way they were presented, were the outcome of other investigations which had a bearing on the test-bar that was used, along with the type of alloy that was under investigation.

It would be advisable, therefore, if more experimental data could be made available on this subject of test-bar and casting properties before any final decision is arrived at for the approval of a standard test-bar.

A test-bar which would give the maximum mechanical and physical properties for any non-ferrous alloy without correlation with the mechanical and physical properties of the alloy in the form of a more complicated casting is of very little direct importance.

The acceptance and rejection of castings is generally based upon chemical, mechanical, and physical properties obtained from a test-bar. It is logical, therefore, that inspectors and the like assume similar properties are possible of the material of the casting the test-bar represents.

There is no other interpretation of such facts, and efforts made to produce test-bars without regard to the mechanical and physical properties of the material of the casting have too little practical importance. The designers are justified in doubting the test-bar as the criterion of the properties they desire to find in castings.

It is a laudable procedure for research workers and foundrymen to strive to obtain the best mechanical

(*Concluded in next column.*)

COKE ECONOMIES RESULTING FROM IMPROVED CUPOLA CONTROL

A notable "case-history" has been reported upon by the Ironfounding Industry Fuel Committee. It relates to a firm in the West Midlands operating two 5-ton cupolas, each working on alternate days. In accordance with a practice which is, unfortunately, still too prevalent in the industry, neither the iron nor the coke charges going to the furnaces were weighed. (It was later discovered that the actual weight of the coke charges was considerably in excess of that for which instructions had been given.) On the recommendation of the Committee a simple platform type weighing machine was installed at the foot of the hoist to the charging platform.

The furnaces had parallel linings of 42 in. internal diameter. The specific melting rate was therefore only 0.52 ton per hr. per sq. ft. It was recommended that the internal diameter should be reduced to 36 in. from the baseplate upwards for a height of about 6 ft. This would give the more efficient figure of 0.71 ton per hr. per sq. ft. As one furnace was due for relining, the suggestion was adopted in this one case. The two alterations outlined above resulted in a coke saving of at least 7 tons per week (28 per cent.), or, say, 350 tons a year, costing £1,250. The value of the weighing machine, which was, incidentally, already available in the works, as it was not being used in its former position, was about £40! As the one cupola lining was modified at the same time as the weighing machine was installed, it is not possible to quote actual figures showing the savings effected by each of the two changes, but of the 7 tons saved per week it is estimated that about 2 tons would be due to the modified lining. A further saving of this order is expected when the second furnace is relined to the new dimensions.

(*Concluded from previous column.*)

and physical properties from an alloy, but what is really desired is that such properties shall be possible of translation to the products of the foundry. It is incumbent upon foundrymen, therefore, not to try to escape their liabilities of producing a casting, the material of which shall have the maximum mechanical and physical properties that are obtainable for any particular non-ferrous alloy, and in conjunction with the research worker efforts should be made within the foundry to design a test-bar which shall have the mechanical and physical properties similar or comparable to a high degree with those of the casting they are supposed to represent.—Yours, etc.,

GEO. MANN.

51, Russell Road, Horsell, Woking, Surrey.
January 26, 1944.

MAGNESIUM FOUNDRY TECHNIQUE*

A description of the manufacture of what is probably the largest casting made under quantity production conditions

By IAN ROSS

(High Duty Alloys Limited and Magnesium Castings and Products Limited)

When the author was asked to present a Paper on light alloys he felt it would be a good opportunity to make some effort to dispel some of the mystery which has been associated with the casting of magnesium alloys. The fact that these alloys need special handling is apt to give the impression of insuperable difficulties from the foundry point of view, and also makes designers reluctant to trust the material.

The actual facts, of course, are that these alloys are comparatively new, and therefore knowledge of them is restricted to a small number of foundries who have specialised in their production. After all, a special technique is required to produce first-class castings in any alloy, be it steel, iron, bronze or light alloy, and once that technique has been established any job which comes along is just another normal foundry problem.

It can be truly said that in the last ten years the foundry and the laboratory have worked much more closely together, both realising that the two jobs are inseparable. The author and his colleagues have long realised this, and a close liaison exists between the metallurgists and foundrymen which results in excellent co-operation and leads to an advancement in knowledge.

Magnesium is comparatively young as an engineering material, and in the earlier stages it was probably rushed along a little too quickly until its limitations were discovered. It was used for many engine parts which work at high temperatures, and these experiments were not a success, mainly due to the fact that magnesium is not strong at high temperatures and is inclined to distort. Since then, however, it has been proved that under normal conditions the magnesium alloys are very strong and can be used for jobs which carry very heavy loads. Typical examples are the hubs for aircraft landing wheels which have been in production for some years.

A number of papers on the more general aspects of magnesium foundry practice have been presented to the various technical institutions, and it was thought to be a good plan, and one of more value to the practical foundryman, if this Paper were devoted to a description of the technique which has been evolved for the production of one of the largest and most complicated magnesium alloy castings which has so far been attempted on large scale production. The casting to be dealt with is a heavy-duty casting, and is undoubtedly subjected to great stress loads.

* A Paper read before the London Branch of the Institute of British Foundrymen, Mr. H. W. Lockwood presiding.

Nature of Casting

The outstanding feature of this component is its size, it is one of the largest magnesium alloy castings in regular production in the world, and will therefore give some idea of the development of magnesium casting in Great Britain. The principal feature of magnesium is its low specific gravity of 1.83, which is about two-thirds of that of aluminium alloys and less than one quarter of that of iron or steel. The design of the casting, which is shown in Fig. 1, is reasonably clean externally, but the major difficulties of its manufacture are chiefly concerned with the fairly complicated system of re-inforcing ribs and the oleo sections which locate the hydraulic gear and wheel suspension. These will be more apparent in a later illustration showing the cores.

FIG. 1.—THE FINISHED CASTING.

Magnesium Foundry Technique

When the production of this component was first contemplated, it was realised that its size demanded a new outlook differing from that usually associated with magnesium founding. The melting and casting of magnesium alloy had hitherto always been a small unit job, due to the nature of this metal with its high chemical activity and readiness when molten to burn in air, which imposes restrictions. These are not usually encountered in any other alloys, and in view of this, the author's company had not attempted to melt more than 150 lbs. of magnesium in a single furnace. This new job, however, required 700 to 800 lbs. of alloy, the equivalent in volume of some 1¼ tons of steel, and it was therefore necessary to make new arrangements for the handling of this quantity of metal. This was done, and the present practice is to melt the metal in two cast-steel pots each with a capacity of approximately 400 lbs.

In accordance with general magnesium practice flux is used, its purpose being twofold. Flux is sprinkled on the metal as it is melting, is stirred thoroughly into the liquid metal to wash it free of all non-metallics such as oxides and nitrides, and it is used finally to form a crust on the surface of the metal to protect it against burning. It is essential to maintain this protective flux covering throughout melting and until within a few moments of actual pouring. It is of interest to note here the unique superheating phenomenon of magnesium. The metal is superheated to a temperature of 850 deg. C., and then rapidly cooled down to its pouring temperature. This exercises a grain refining effect on the alloy.

Pattern Work

The construction of the pattern equipment, shown in Figs. 3a and 3b, follows the orthodox method used for quantity production. Mahogany is utilised, in the main, with metal inserts at all the wearing parts. The pattern is naturally split at a point suitable for coring up, and each half is dowelled on to separate boards to facilitate production. All runner channels are fixed to the boards and feeder pads are fixed to the pattern to ensure correct location.

The moulding boxes are made of good quality aluminium alloy on the sectional principle. The boxes measure 7 ft. 6 in. and 6 ft., the top part being 24 in. deep and the drag 10 in. Handling is by means of single trunnions at each end and adjustable slings on the crane beam for balancing purposes. This type of moulding box has proved very satisfactory, and no signs of springing have been experienced despite a total weight of 3½ tons when the top is completely rammed up. The actual moulding of the job is fairly straightforward and does not present any difficulties but, naturally, atttention to details is very important. The use of water for mending up or damping the joint is forbidden owing to the violent re-action of magnesium if coming in contact with excessively damp areas in the mould, and this, no doubt, would give many moulders, working in other metals, cause for thought.

The sand is of synthetic type consisting of washed silica sand 40 to 100 mesh, bonded with bentonite or similar clay, with 2 per cent. ammonium bifluoride, which is used to inhibit the action of the molten alloy with the moisture of the sand.

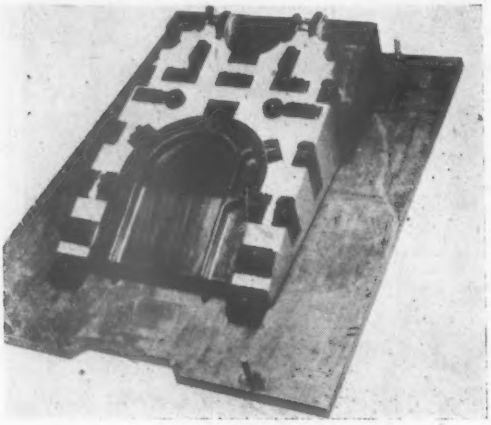

FIG. 2A.—THE PATTERN IS IN TWO PARTS; THE SECOND PART IS SHOWN IN FIG 2B.

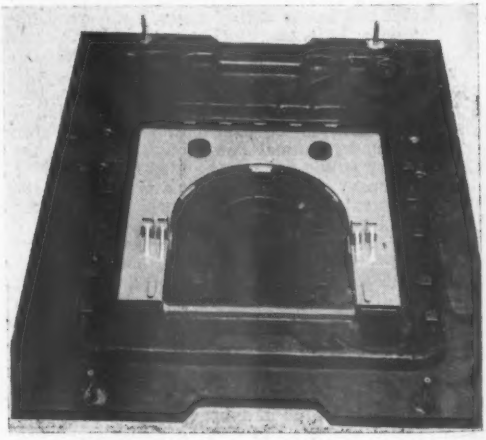

FIG. 2B.—THIS PART OF THE PATTERN CARRIES INTEGRALLY PART OF THE RUNNER SYSTEM.

Moulding

A Sandslinger is used in making up both halves of the mould, and this has eliminated much of the arduous and slow hand ramming experienced in the early days. It will be noted from Fig. 3 that practically the whole of the bottom surface and the sides of the mould up to the joint line are chilled. This has been found necessary, for with the bottom running system chills promote the progressive solidification which is necessary for satisfactory feeding to take place by the large top risers.

Although it is essential to cover this large area with chills, it is important that there are gaps of sand left between them in order that the chilling effect is steadied down somewhat. To achieve this special chills are made in the form of small ladders, and before they are placed on the pattern the gaps are filled with sand. Apart from the advantage obtained from the technical point of view, this considerably helps the moulder in the placing of his chills, and incidentally improves the as-cast finish of the castings. Before use, all chills are thoroughly cleaned by shot blasting or other mechanical means, and when the moulds are finished off they are coated with a dressing of iron oxide and petrol to prevent condensation of moisture.

Core Making

All coreboxes, one of which is shown in Fig. 4, are made with mahogany with metal joint faces and inserts are arranged to combat wear. In the early stages of production an experimental machine was made to promote accurate and clean core production, the working principle being a balanced rollover frame holding the corebox for easy manipulation, the core drawing away from the box, controlled by an oil/compressed air cylinder device. It was found that the amount of damage and maintenance to the coreboxes was so considerably reduced that additional

(*Continued on page* 96.)

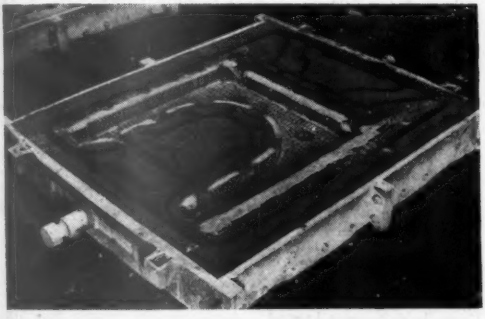

FIG. 3.—DRAG READY FOR CORING UP.

FIG. 4.—COREBOX ON MACHINE.

FIG. 5A.—THE TWO MAIN CORES ARE SHOWN HERE AND IN FIG 5B.

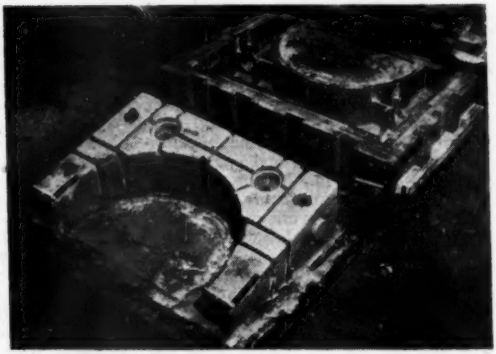

FIG. 5B.

SPECIFICATIONS AND THE NEED FOR CONTINUED RESEARCH

By ECCOSAIS

All foundrymen are familiar with material specifications, particularly in connection with service contracts, Although this business of specifications is very much overdone in some cases, the hazard in many cases is such that it is far better to overdo than take risks which may lead to loss of life or even disaster.

A specification may be a serious hindrance to production, due to the inability of an inspector to decide upon a reasonable interpretation. Although most of the materials in general use are covered by B.S. Specifications, it is found that individual firms still continue to issue their own specifications. The writer has had some experience of the latter where an attempt to cope with the multiplicity of specifications would mean numerous changes in furnace charges; excessive skilled attention and space for the purpose of keeping the different varieties of scrap separate. The method adopted successfully to avoid the above is to have a good quality general purpose material which is offered as an alternative if a firm is to accept the work.

The service departments are sometimes guilty, and for example will ask for Admiralty gunmetal to have a tensile strength of 17 tons, the B.S. Specification calling for 16 tons. An interesting experience in this connection is worth recounting. A number of castings in sets of 70, varying in size and shape, were on order in this material. In each mould, which might contain 10 to 24 assorted castings, a test-piece must be cast. The test bars and castings from one pot of metal would be isolated and held until one of the test bars, stamped with the batch number, had been tested and approved. If the first test failed a further two bars would be tested, and if these were satisfactory the batch of castings would be accepted. If one of the two failed the whole of the batch would be rejected. The management first had to learn how to make test bars, because if these were good it was taken for granted that the castings were good. After the making of test bars was mastered free from any faking, the firm rarely had a reject, and the test results were invariably much higher than called for. The method of obtaining good test bars was to cast them always in the same position relative to the pouring gate in a vertical position. A variation in the position by $\frac{1}{4}$ in. in any direction would give a low result, and to ensure uniformity the patterns for gate and test bar were in one piece.

[A table submitted but not published detailed 326 consecutive tests, out of which only five failed to satisfy the specification requirements of 17 tons tensile strength and 8 per cent. elongation—EDITOR.]

The table lists 320 good bars, out of 325 cast in Admiralty gunmetal. The highest tensile figure was 24 tons per sq. in. (the limit of the machine), whilst the highest elongation was 55 per cent. The five batches referred to were scrapped with an additional three batches made prior to the firm's ability to make test bars, a total of 400 to 500 castings.

It is interesting to note that no test bars are now required, Admiralty gunmetal (88 per cent. Cu, 10 per cent. Sn, 2 per cent. Zn) being replaced by ounce metal, with 85 per cent. Cu, 5 per cent. Sn, 5 per cent. Zn, and 5 per cent. Pb.

Transit Plugs

So much for the trouble taken with Admiralty gunmetal. Now for a specification of quality of castings for transit plugs in cast iron:—(*a*) Must be machined all over; (*b*) must have a $\frac{1}{4}$ in. slot machined in top; (*c*) must be free from blowholes, and (*d*) must have various hieroglyphics stamped on top face. Moreover, the inspector must be allowed to break a proportion to see that metal is suitable.

The inspector first seen knows what discretion is and how to use it, and when he sees one or two pinholes in the tops of castings, gives the decision that up to a certain point such castings need not be rejected. Junior inspector No. 1, after a period apparently becomes panicky and rejects a batch of about 700 accumulated out of about 60,000 for small blowholes previously approved by the first inspector. The makers refuse to have them rejected and appeal to the Chief, who sends down another man, resulting in acceptance of 650 out of the 700. The management originally wanted to cast the slot in and also the hieroglyphics and dispense with machining the top, but the chief inspector of C.I.A. would not agree. In such cases small blowholes would not show up and were not detrimental anyway.

The author's firm has since made huge quantities of a similar type with slot, hieroglyphics, and lightening hole cast in. Hundreds of pounds of public money would thus have been saved if his original suggestions had been adopted. Additionally, much machining capacity would have been available for other purposes.

Cast Iron for Gear Boxes

Another specification called for the addition of 2 per cent. of nickel for certain gear boxes in cast iron. For practical and economic reasons, the management refused to work to this specification and offered its standard housing iron, having a tensile strength of 18 to 20 tons per sq. in. This was accepted and proved very satisfactory. Thus the necessity to provide separate storage space for yet another variety of scrap iron was avoided. These are modern times, and what is going to happen in the foundries which ultimately have to melt and use all the different varieties of iron available after the war! It would almost pay to remelt in large quantities for the benefit of the foundry trade, additions being made to produce one or more standard compositions.

Shell Forgings

Now for a case of steel shell forgings, the specification for which stated that they must not be water

(*Continued on page* 99.)

NOTES ON OIL-SAND PRACTICE IN THE ORDINARY FOUNDRY

A summary is given of the advantages of Stack Moulding, followed by a warning as to Oil-Sand Reclamation

By WM. Y. BUCHANAN

(*Concluded from page 76.*)

Assembly

The assembly of the stacks is carried out by first placing a drag box, with the flat bars level and partly filling and levelling with green sand. The lowest or bottom "core" or block has of course no down gate, and each successive block is registered merely by placing the sides in line. No pins are necessary, but a short piece of round wood may be used to make sure that the down gates are strictly in line. It is usual to rub over the inside of the mould surface with a piece of emery paper as this smooths off any small pieces of sand which may have been brushed into relief by the blackwashing process.

The mid-parts or frames are then placed in position and rammed up with floor sand. Any old discarded machine boxes will serve for this purpose, if the bars are broken out. It is beneficial to separate the mid-parts with small pieces of scrap in order to allow the free passage of gases during casting. The top box should be a few inches above the cake or top core and bars laid across the box, a large weight put on the bars and the core wedged down by driving wedges between the top core and the bars supporting the weight. The runner basin may then be made up ready for casting.

Advantages of the Process

The "core box" can be made in an hour or so and if one or two of different sizes are made the pattern can be frequently changed so long as the runner is left in one position, these can be stacked indiscriminately. If this "core box" is mounted on a jolt rollover machine a very rapid production can be obtained and after drying these can be stored or handled with ease. The oil sand cores or blocks can, however, be just as readily made by hand or on a plain jolter and roughly handled; for example, in turning over it is not necessary to put the core plate on the box, clamp them securely and then turn them over together. All that is necessary is to place the core plate on a bench. stand the core box on edge in the correct position and then drop it over smartly on the plate, then lift off the box as the core or cake will loosen usually with the force of the impact.

Where an assortment of castings with various numbers required is available, the moulder can remove these or work them loosely for registration purposes. For double-sided work it is simply necessary to use two half-patterns or one only if the halves are exactly the same. The depth of sand may be cut down to a minimum, for example 1½ in. of sand between castings 1½ in. thick. By this means a large number of castings have been cast in a stack, one example being 5 or 6 castings per block 21 high—5 ft. 3 in.—giving a total of 105 castings per stack.

When the thickness of the casting is over 4 in., that is small bulky castings, say, 4 in. thick and 10 in. dia., the sand between each casting should not be so attenuated that the oil of the sand has burned out while the metal is still liquid, otherwise the lower casting will be lost, due to excessive swelling or running together. This will happen when the thickness of sand is reduced to the region of 1 in. It is, however, worth while sacrificing a stack or two to get this experience in order to take full advantage of the great strength of this moulding material.

Many castings such as "wedges," slides and taper motion bars, are required in a large number of types with small numbers of each, to be machined all over, and these when cast flat are difficult to obtain entirely free from small specks of sand in the machine surface when made in dry sand. The use of good oil-sand eliminates this, largely due to the stronger edges and corners in the ingates, etc.

The extra pressure of metal to be associated with stack moulding in oil-sand is very beneficial, when freedom from porosity is required in difficult sections, and the method has been successfully applied to pressure-tested jobs without the use of risers, chills, etc. The increased production per unit of floor needs no stressing, 21 boxes 30 in. square would require a large area because it is not only the row but the casting clearance between the rows which must be considered. The close packing of castings give a very decided annealing effect which facilitates machining and for this reason a hard close grained metal may be used without any danger of white edges or fins.

Reclaiming Oil Sand Lumps

Oil sand practice is almost invariably carried on in the same part of the foundry as dry sand and green sand work. This brings up the immediate question of recovery of burnt oil-sand and at the same time the possible effect of quantities of burnt oil-sand filtering into the foundry floor or sand system. The author has dealt with this aspect of oil-sand practice in a previous paper devoted to "Salvage of Materials."

There is no doubt that a considerable proportion of recovered burnt sand cores can be re-used in the place of new sand. Another point which arises is that where the dry sand has been operated for a number of years as a closed circuit with very small quantities of new sand only being brought into the

Oil-Sand Practice

foundry and operated with very little discarded material, the use of oil-sand either using new material only or partly recovered sand, upsets this nice balance of supply and demand which is ideal. However, when the oil-sand is used extensively, even allowing for the completely burnt material coming into the floor, there still remains a considerable quantity of large, very hard lumps of oil-sand to dispose of by one means or another.

The continual influx of new sand for oil-sand making always requires considerable disposal, and as such is a constant source of expense. It is theoretically possible to use the same sea sand over and over again for making oil-sand if allowance is made for the

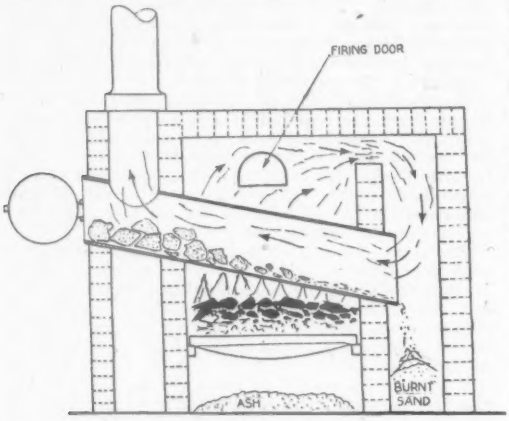

FIG. 22.—SKETCH SHOWING THE TYPE OF EXPERIMENTAL FIRE USED FOR BURNING OFF OIL SAND LUMPS.

defects of this system such as the increased amount of oil binder required and the reduction in permeability. It may be interesting to refer, in passing, to an alternative method of dealing with these lumps of broken oil-sand cores which are normally ground up in pan mills or similar crushing machinery in the process of recovery.

Fig. 22 illustrates the type of burning apparatus used, a cast-iron tube about 12 in. bore is built into the fireplace as shown in the sketch. The tube actually passes through the fire in such a way that the outside surface was subjected to an intensive heat while the products of combustion had to pass through the tube itself on the way to the chimney. The oil-sand lumps were charged into the open end of the tube, which was then closed with a sheet metal door in order to maintain the draft of the chimney.

The object of the whole process was to burn out the oil binder and the tube itself sloped slightly so that the burnt material trickled through into a pocket or chamber through which it could be withdrawn periodically. This idea works quite satisfactorily, but it very soon became evident that the amount of fuel required per ton of oil-sand lumps burned in this way made the process entirely out of the question economically. The economic aspect is of course more important than ever during war-time. The only reason for mentioning this uneconomical process is that it should be recorded as such for future reference.

Core-shop Machines

Hand-jolt and turn-over machines are capable of good output for cores that draw freely and can be turned out on a plate, *i.e.*, most types of split cores. Core-blowing consists of introducing sand into a core-box in such a way that it rams, compressed air being used to convey the sand. There are several types of machines, but mainly two classes. Most have the blowing chamber above the corebox. Others have the blowing chamber and corebox set horizontally.

With ramming the operation is complete and so stripping and drying must be arranged for as though the cores were made by hand. There are some very distinctly successful applications of core blowing in the field of mass production with mechanical means of bringing up sand and removing the cores. Special carriers are usually supplied to fit the lower half of the corebox so that the core in the green state can be turned out and dried in correct shape.

The application of core-blowing to ordinary wooden boxes of great variety and from which small numbers are required is a different matter, and naturally the output will not be in the region of, say, 1,800 per shift as is obtained in some specially suitable mass-production examples. The limiting factor will usually be the rate of stripping, so the first essential is blocking out or splitting cores to get a flat surface with a good draw in order to turn out on a plate.

It is usually impracticable in the ordinary foundry to make special shaped driers, although the usual method of packing up the core with loose sand before turning out is quite efficient. It seems best to have a number of boxes working at once. These are blown by an unskilled man who places them within reach of several coremakers, who strip and return the boxes for blowing. The operation of blowing only takes a matter of a few seconds. Where several boxes are in use in quick succession, it is convenient to keep a number of handy pieces of wood to be used as packing, and thus save frequent setting of the clamps. The blowing plate in the horizontal machine with which the author is familiar is universal, *i.e.*, it is not changed and the vent board is best made large enough to cover the biggest box to be blown.

There is a central orifice for the introduction of the sand, and this is placed over the hole in the blowing plate. The remaining area of the plate is then drilled every $\frac{1}{4}$ or $\frac{3}{4}$ in. and covered on the inside with fine copper gauze with little grooves along the other side. This allows the air to exhaust rapidly in front of the

ingoing sand and thus eliminates air pockets of soft spots in corners. These corners can readily be drilled and the hole covered with a little piece of gauze to help even ramming in inaccessible corners.

The boxes can be protected by pieces of tinplate, where the sand is likely to strike violently, and this prevents erosion of the pattern surface. The boxes should be strongly constructed, because it must be remembered that a pressure of 80 lbs. per sq. in. is exerted over the inside surface. The sand most suitable for blowing is oil sand of low green strength and free from clay-bonded sand additions, i.e., high flowability.

The properties of blowing sand are good permeability and even running, and these properties are more marked than in other methods of ramming. It is also said that the surface is close and smooth due to the fact that the large grains tend to go to the centre, while the small grains go to the surface—an ideal state of ramming for coremaking.

Discussion

The BRANCH-PRESIDENT (Mr. Kirby), after complimenting the author, asked whether Mr. Buchanan could give him a representative permeability for cores for steelfoundry practice, and why a core made by blowing was lighter and more permeable than a similar core made by hand-ramming and that, even when of the same weight, the blown core was more permeable than the hand-rammed one. Again, why was a round core made in a rotary core machine superior to a hand-rammed core of apparently equal degree of ramming?

Permeability of Steel Moulding Sands

MR. BUCHANAN, in reply, said that he would hesitate to give any figure for core permeability applicable in a general way to steel moulding without knowing some of the particular applications, details and design in which the cores would be incorporated.

By blackboard sketches, the lecturer showed the superiority in permeability of blown cores over hand-rammed cores, and how in hand-ramming a series of zones of hardness were produced, sometimes resulting in a parting and over-close ramming immediately below the rammer. This hardness varied from the foot of the rammer to the position of the last blow of the rammer. Thus it was possible to have an average ramming of, say, 1.5 density, but this was composed of zones varying from 1.8 to 1.2; on the other hand, a blown core would have an average ramming density of 1.5, with little or no variation throughout the section. The hand-rammed core, which had zones of 1.8 density, would be found to have a permeability controlled by this higher figure, tending to give a poor permeability and at the same time having local positions giving low ramming of 1.2 density which would encourage local searching, particularly in the case of bronzes, etc. The figures given are, of course, purely for the ease of explanation and may be exaggerated. although Mr. Buchanan said he had confirmation of this tendency from extensive experiment, and he thought the explanation put forward here explained the superiority of blown cores over hand-rammed cores, all other things being equal. The same explanation would apply to explaining the difference between cores made in a rotary machine and hand-rammed ones.

MR. W. BRAIDWOOD also congratulated the author on the excellence of his review on core-making practice, and said that he was largely in agreement with all that had been said; he particularly wished to associate himself with the statement that the powdered binders now in use were a great improvement on the hundred and one types of core oils and mixtures which use to be common. The new type of core compound was easier to measure to handle and to mix. He asked what was the object of using clay-bonded sand with oil sand when clay was shown to use correspondingly more oil. The statement that maximum dry strength was obtained with sand and linseed oil as in personal experience showed that certain mixtures of linseed oil plus dextrine gave the highest dry strength. He agreed that the wear and tear and the incident maintenance on oil-sand mixing machines was very important, and described how the replacement of a checker plate in the bottom of a Pneulec mill had been at least postponed for some time by reproducing the checker marking with a portable welding set. This he inferred could be done very quickly and obviated the necessity for renewing the plate entirely.

Natural Sand Additions

MR. BUCHANAN, in reply, said the natural sand had been added to oil-sand mainly to prevent sagging which occurred in heavy cores made by hand. The nature of the work was more akin to foundry practice where expensive formers and carriers could not be universally applied. With regard to the question to whether linseed oil only gave a maximum strength, this statement was only intended generally and was based on some research done a number of years ago. He was quite prepared to accept Mr. Braidwood's statement that linseed oil and dextrine in certain preparation gave higher dry strength than either of them singly. His remarks about patching up a bottom plate of the Pneulec mill in order to eliminate extensive replacement was a very good example of what he (Mr. Buchanan) had in mind in stressing the value of careful supervision of maintenance.

MR. HAMILTON asked what type of washed silica sand carried 5 per cent. of clay.

MR. BUCHANAN said that this figure was yielded by the A.F.A. clay test and consisted of all material which would not settle faster than 1 in. per minute in water. It was true, of course, that this figure might also include fines with very little bonding quality but nevertheless, Irvine sand was tested in the same way and only showed 0.17. Then again, since both clay and fines absorbed a higher proportion of core coil, the result was the same.

MR. TYRIE asked the speaker whether he could confirm an experience of his own where clay-bonded sand was introduced intentionally to oil-sand in order to offset the tendency to over-baking or burning.

Oil-Sand Practice

MR. BUCHANAN said this was quite true, the percentage of clay-bonded sand could be increased as much as desired and the properties would gradually change from that of oil-sand very sensitive to over-heating to that of clay-bonded sand capable of standing very much higher temperatures.

MR. MORTIMER said the author's remarks on the effect of diminishing grain size increasing the consumption of core oil reminded him of his own experience, *viz.*, that over-milling tended to increase the amount of fines by breaking down the grains and this eventually used more core oil. He would have liked more information on the test made on proprietary core binders because he himself had found it necessary to test a number of these.

No Evidence of Grain Crushing

MR. BUCHANAN, in reply, said that he had not found any evidence in his own work of crushing of grains due to over-milling so long as the rollers were prevented from running on the bottom but over-mixing generated considerable heat and this literally used up part of the oil. The resulting powdered core sand in turn requires some core oil to bring it to reasonable moulding condition. He had carried out tests on proprietary core binders but had refrained from giving comparative results as this was bound to please some and displease others. For that reason in the only reference on proprietary core oil in the paper he had referred to these as A, B, C, and so on. He could have shown Mr. Mortimer that he had tested 101 and he was glad to agree with Mr. Braidwood that the number of core oils available to the foundrymen was less than a number of years ago. Mr. Mortimer had said that he disagreed with the speaker on the necessity for gumming or coating core wire for oil-sand cores. He thought he could get out of it by saying that the blocks for stack moulding were heavy lumpy pieces which, properly speaking, would be called moulds in which the uncoated rods could be used whereas for intricate cores he would agree that wire could beneficially be coated with core oil solution or clay wash.

A MEMBER said that in coming to the Clyde district he noticed an excessive use of iron grids which were altogether unnecessary in oil-sand. He asked if Mr. Buchanan could explain why this was so.

MR. BUCHANAN explained that the moulders in this district were largely floor moulders by training, accustomed to making fairly big cores. The grids, he thought, were used mainly to prevent sagging during the green state. He had some experience himself where sometimes a core of 20 in sq. by 15 in. high was found to contain an extensive number of rods of all shapes and sizes. He found that if instructions were given to eliminate rods almost entirely, the moulders were able to demonstrate quite convincingly that the cores made without irons would sag, so that a certain amount of latitude was necessary in large cores made without formers.

PATTERN INSURANCE

Because it happens to be of American origin, and perhaps therefore not fully applicable to British conditions, it is not proposed to publish a comprehensive article by Mr. W. C. Anderson on "Insurance Protection for the Patternshop Operator and His Customer," which was printed in the "American Foundryman." Obviously, the three main types of coverage are:—(1) Insurance protection on a foundry's own patterns; (2) protection on customers' patterns whilst in the jobbing shop; and (3) protection on a foundry's patterns whilst on other people's premises or during transport. Other risks cited by Mr. Anderson are those entering into the category of Acts of God; industrial or civil riot; aircraft, smoke and vehicles, which are generally covered by an endorsement at extra cost, and appear to be usual in America. A further insurance covering loss of profits due to the loss of patterns is often arranged. Where a sprinkler is installed, it is usual to insure against damage from leakage. Of course, war damage, to include vandalism and sabotage, is a modern feature. The insurance of an individual pattern, the destruction of which would hold up production is also novel.

MAGNESIUM FOUNDRY TECHNIQUE

(*Concluded from page* 91.)

machines were ordered, and there are now a number of these machines in use on production, one for each of the large boxes. Some idea of the life of the boxes when fixed to these machines can be formed from the fact that when one set of equipment was withdrawn for overhaul after well over 1,000 cores had been produced, only superficial repairs were necessary.

Venting is effected mainly by channels of clinker embedded in the cores, and all cores are examined and checked with gauges by a core inspector before handing over to the moulders. Cores not immediately required are stored in an oven at a temperature of about 60 to 80 deg. C. Re-inforcement of the rather delicate cores (Fig. 5) forming the interior of the oleo legs and arch is effected by means of special interlocking bars to facilitate easy removal at the core knock out stage. It is again an interesting fact that no core wash is applied to any of the cores, the coremakers being relied upon to produce a clean surface and permeability is therefore not impaired.

Washed and graded silica sand is bonded with a proprietary (Crulin B) core binder, with ammonium bifluoride inhibitor added. The internal ribbing system can be seen in Fig. 5b, and it will be noticed that most of the junctions in changes of section have been chilled. This is necessitated by the tendency of magnesium alloy to develop shrinkage in the form of surface sears or as intercrystalline porosity at changes of section. The cores are baked for about three to four hours at 250 deg. C., according to bulk.

(*To be continued.*)

WARTIME FOUNDRY RAW MATERIALS

CONDITIONS IN THE WEST RIDING

Discussion reveals how shortages are being overcome

The West Riding of Yorkshire Branch of the Institute of British Foundrymen devoted one of its autumn meetings to discussing the present quality of the raw materials used by the foundry industry. Mr. L. Turner, of Elland, presided over a good attendance of members.

MR. A. R. OLDERSHAW said the object of foundry control was uniformity, and this was difficult to maintain under present conditions. Manufacturers of all the materials used in the foundry were experiencing a similar difficulty in obtaining the majority of their own essential requirements, and therefore had had to look around for substitute materials. It was these substitutes which had caused considerable worries to the foundryman.

The better grades of coke had varied very little, but users of the lower grades would have noticed large variations with each consignment. This, however, applied to some extent even before the war, and it was safe to say that, broadly speaking, coke had suffered comparatively little from the effects of war. Pig-iron, on the other hand, had suffered in quality as well as being in short supply. All the best quality pig-iron, *i.e.*, of low phosphorus content, was fairly scarce, especially hematite, which was reserved for the steelmakers. The foundryman replaced it by either using large percentages of steel in each charge in the cupola, or by making his own refined iron at the end of each blow. The majority prefer the latter method, for if high steel charges are used it is only dilution of the pig-iron, and therefore all the elements are proportionally reduced. By using the second method the resultant pig-iron can be analysed and the necessary adjustments made when the pig is re-used.

High steel charges had a very serious effect on cupola refractories, shortening their life appreciably. This was serious at the present time because of the difficulty of obtaining new cupola linings—due not so much to lack of the necessary materials, but to the shortage of labour at the brickworks.

The Scrap Position

Turning to the question of scrap, Mr. Oldershaw said good quality cast iron scrap was very difficult, if not impossible, to obtain now. The lower grades of cast-iron scrap were plentiful, but could only be used in limited quantities where high-duty castings were made. A method adopted for using up this type of scrap was to use a proportion of one's pig-iron and steel scrap when making refined iron. Another method was to use this type of scrap for any jobs which did not have to be machined, or which did not call for any particular property. The resulting heads, runners, risers, etc., could be analysed and returned to the cupola for use in some particular job.

Steel scrap was plentiful, but if of a size suitable for the cupola it was scarce. As very small pieces it could be obtained freely, but this type acted adversely in respect to the controlling of the composition of the resultant metal. The reason was that it dropped down the cupola stack passing between the bigger pieces of pig and scrap. The result was premature melting of this steel, producing hard spots and fluctuating analyses with very low carbon. This type of metal was very difficult to handle in the foundry.

Oil Binders

Another material which was causing much concern was the oil used as a binder in making cores. Very great care had to be taken with the control of the oil if consistent results were to be obtained in the dried core. Drying temperatures, drying times and the storage of these cores had to be carefully controlled. One of the most serious shortcomings of the oil binders used at present, excepting linseed oil, was the softening and breaking down of a core in storage, even if stored in a dry, well-aired room. Another, and the most serious, fault was the objectionable fumes these cores gave off during the drying period, and especially during casting. These fumes were a problem, especially as most foundries were permanently blacked-out, making working conditions very bad. This results in lowering the efficiency of the men who had to work during that period.

Where the foundry was small, it could be overcome by the installation of a ventilating system, but for a large foundry the plant required for adequate displacement of all the foul air would be prodigious. The only method available for the large foundries which had no special ventilating system was to close the foundry for an hour, switch off all lights and open all doors and windows. After this the atmosphere should be comparatively clear.

Mould Facings

Mould facings, whether of the wet or dry type, had suffered considerably through war conditions. The dry type, usually, was imported, and therefore in short supply. As a result it had been adulterated with blacking. This was readily noted when sleeking a mould and especially when the fingers were used for this purpose. It did not yield that soapy feeling as did plumbago. If this wartime facing was not securely attached to the mould face, it ran in front of the metal when the mould was cast and collected in patches, with serious effect if the casting had to be machined.

The wet type of facings had suffered also. The base of the material is unchanged from pre-war days,

Wartime Foundry War Materials

but the bonding materials used have had to be changed. This type of facing was composed of finely ground coke mixed with a plastic refractory clay or gum. This clay was a bentonite, which was very refractory, but it, too, was in short supply, and other clays had to be used, with the result that, if the same dry stretch was required, approximately twice the volume of clay was needed. This extra amount of clay created more ash, with the possibility of dirty castings; or, if the same amount of clay was used, it was possible for the metal to lift the mould facing, with similar results.

Chaplets, studs and pipe nails had varied, but little so far, but doubtlessly in the future these articles would have a coating which would replace the usual tin one, as this metal must be conserved for more important uses. In the near future foundrymen may have to buy untinned chaplets and studs, etc., and coat them with tar, creosote, red lead, or some proprietary material.

A Wrong Impression

Mr. H. Forrest, opening the discussion, said he hoped Mr. Oldershaw had not, by his observations, given anybody an impression that it was almost impossible to make good castings under war conditions, although it would be agreed that it was a time of considerable difficulty, and one had to use much thought and ingenuity in meeting these problems. Nobody denied that bentonite was really good, but there were other bonds available which were indigenous and which, with care, were good substitutes for the American product. There had been too great a tendency to use low phosphorous pig irons for every kind of job. By their use a certain amount of porosity trouble was overcome, but the fact that founders were not now able to use these irons with the familiar freedom had caused them to look elsewhere, and they were all the better for the mental stimulus which this and other difficulties put in their path.

MR. OLDERSHAW said he hoped he had not given any impression of impossibility in making good castings. He merely wished to give a brief general review of the difficulties war-time had created. His own experience had been that bentonite gave very good results, and it was bound to be missed when it could not be obtained. He was a little hesitant as to the use of refined irons in place of hematite, and was inclined to treat them with some caution.

Chaplets

MR. J. TIMBRELL, referring to chaplets, said the majority of heavier chaplets were probably galvanised, and he wondered whether that was perhaps a cause of leakage in pressure resisting castings. Had Mr. Oldershaw used any type of home-made chaplet without any dressing?

MR. OLDERSHAW pointed out that he did not say it was impossible to get tinned chaplets, but that conditions might change. He would not use a chaplet with galvanised coating for any heavy pressure work, because the zinc would oxidise and yield a porous job. He had used many types, but the best materials so far was red lead, paraffin and linseed oil. They would allow the metal to set against it without any blowing.

MR. F. OLDERSHAW (past-president), referring to cast iron chaplets, said a good method to ensure soundness at points of contact was to replace dressings either by a dilute sulphuric acid or hydrochloric acid pickle, followed by an ammonia wash and a drying off in sawdust.

MR. W. G. THORNTON said that the author had mentioned existing and some potential difficulties. There was, however, a chance of being called upon to use fuel in air cupolas with a very high percentage of sulphur. How would Mr. Oldershaw deal with fuel which would yield 1.5 per cent. sulphur in the metal?

MR. OLDERSHAW said he would increase the percentage of manganese in the metal by adding ferro-manganese to the charges.

MR. G. W. NICHOLLS said that with 1.5 per cent. sulphur in the metal, there was liability of machining difficulties even if it was neutralised. To neutralise such excessive sulphur effectively would need 2.5 per cent. manganese minimum. Obviously desulphurisation by soda ash would be more satisfactory.

MR. F. K. NEATH, B.Sc., thought Mr. Oldershaw was rather severe on the refined iron producers in his opening address. Many founders were having to make high-grade castings for war purposes, and if they could use refined iron and produce the better-grade product required it might take them beyond the technique to which they were accustomed before the war.

MR. OLDERSHAW said he did not wish to give the impression that he would not use refined irons, but if he had a choice between hematite and refined iron he would select the former, as a result of personal experience.

Following on a remark by Mr. J. Blakiston that he believed an original method of desulphurisation was by charging raw salt and lime into cupola, MR. THORNTON raised a question as to whether that was not likely to have a serious effect on the cupola lining?

MR. BLAKISTON said he was only asking for information, but he supposed that with soda ash there was a liability of damage to the lining also.

Basic-Lined Cupolas

MR. FORREST said he believed some revolutionary results had been obtained at the Ford motor works, with the use of dolomite linings, in the direction of both sulphur and phosphorus reduction. Details, he believed, were not yet available, but the possibilities of de-phosphorising were extremely interesting.

MR. FORREST asked if anybody present had tried sodium silicate as a core binder?

MR. BLAKISTON said he had, and it made excellent cores, but once they were set it was difficult to know which was the harder, the casting or the core!

(*Continued on page* 99.)

PLASTER FOR CHILL PATTERNS

BY "CHECKER."

When making patterns for chills, it is important that the correct shapes are obtained, so that there will be no disfigurement of the casting, if these patterns are made in wood much time will be spent in working and fitting the wood to match the shapes of the pattern for which the chills are required, especially where the chill has to be of an irregular shape.

This time can be cut down considerably by making the chill patterns of plaster. Fig. 1 shows one of several parts of a pattern for which chills were required, with the part to be chilled shown dotted. A rough frame was made as shown in Fig. 2, and this was placed in position on the pattern as shown in

FIG.1

FIG.2

FIG.3

Fig. 3, and the plaster poured in. All awkward shapes and angles are automatically reproduced by the plaster without fitting, and the outside shape of the chill pattern, which is less important, can easily be worked to the shape and thickness desired with very little effort before the plaster becomes too hard, after the frame has been removed. On some occasions it will be found an advantage to work the outside shape while it is still in position on the pattern.

It is possible that, if some of these patterns are made in wood, they will twist or warp out of shape on completion, owing to the irregular shape and the thin sections required depriving the patterns of much of their strength. This, however, should not occur with plaster.

ACCORDING TO "THE TIMES" the largest bell of St. Sophia's Church, Novogorod, has been recovered after having been buried during the 2½ years occupation of the city by the German army. It was cast in the 17th century, and its peal could be heard for 25 miles.

Two smaller ones have still to be dredged from the river bed.

SPECIFICATIONS AND THE NEED FOR CONTINUED RESEARCH

(*Concluded from page* 92.)

cooled. After a yard full of shells had been rejected because test-pieces taken from the walls of samples would not give the required results, the works manager remembered his experiences during the last war. Based on these, he instructed his foreman to disregard the embargo on water cooling, and fill up with water each hot shell forging. After several batches had been treated thus with good results from the test-pieces, the yard rejects were treated similarly with success.

The works manager received an urgent summons for an interview with an important Government inspector. After practically handing over the reins to his assistant in anticipation of his discharge, he attended the interview. He was asked how he accounted for his success in shell production, and told the truth and "hang the consequences." He was complimented and told to carry on similarly with the larger shell forgings. Like the Nelson incident, when he applied the telescope to his blind eye, there is a considerable amount of risk in such methods, but, if they come off, all is forgiven—sometimes.

The foregoing examples show the need for continued research, and the value of the individual who is not hide-bound by convention and has sufficient persistence to press for the adoption of methods other than orthodox. Many modern improvements and developments in all industries can be traced to such individuals, who themselves would be far from comfortable trying to carry out the duties of inspector as interpreted by many Service departments.

WARTIME FOUNDRY WAR MATERIALS

(*Concluded from page* 98.)

MR. F. OLDERSHAW asked if anybody had had experience of pitch binder. Mixing ordinary pitch with core sand produced some very good cores. By controlling baking the cores will carry a good clean blue finish inside, and they would drop out; that is, they did not need knocking out.

MR. THORNTON asked as to whether the fumes were obnoxious?

MR. OLDERSHAW replied that they were so bad that the experiments were discontinued.

MR. THORNTON said an incorrect baking temperature was liable to cause blown castings.

MR. OLDERSHAW replied that by using a natural sand and just sufficient pitch to cement the grains with proper drying there was no trouble.

The session ended with a vote of thanks to Mr. A. R. Oldershaw for introducing the discussion, on the motion of MR. H. BALME, seconded by MR. NICHOLLS.

HOT TEAR FORMATION IN STEEL CASTINGS

Mr. C. W. Briggs answers Conference Discussions

MR. CHARLES W. BRIGGS wrote, in reply to the discussion, that he was very greatly indebted to Mr. Fassotte for his review and remarks regarding the Paper. It was indeed an honour to have Mr. Fassotte introduce the Paper to the Institute; his knowledge of the fundamentals of steel casting production is well known and widely appreciated. The writer was very much interested in the remarks of Mr. Fassotte regarding "the British foundry which had a run of hot tears at the inside of a flange at the end of a particular casting." The writer has been in contact with the same type of hot tear located in the flange section of high pressure fittings, at several foundries in the United States.

Seven Points

The seven points of comparison which the British foundry had employed are interesting, and it is believed that some comment could be made on these points:

(1) Both basic and acid steels were tried. Generally speaking, the behaviour was the same, though results with basic steels were slightly better.—*Comment*: This is in line with reported results.

(2) The carbon range of the steels used between 0.2 and slightly above 0.3 per cent. Tears were equally persistent with all the carbon contents.—*Comment*: The Paper showed that there was little or no difference between 0.20 and 0.35 per cent. carbon steels. Studies should have been made on steels of 0.10 to 0.15 carbon contents.

(3) The sulphur variation in the steels employed was between 0.02 and 0.03 per cent., with no noticeable difference in results.—*Comment*: Steels of sulphur content under 0.02 should be compared with steels of sulphur content of about 0.05.

(4) The phosphorus variation between 0.02 and 0.04 per cent. gave no continued different behaviour.—*Comment*: None would be expected in this range.

(5) The steels were examined for non-metallic inclusions without yielding any information. Sections of defective castings have, however, been sent to the author, and he may have a different opinion on this point.—*Comment*: In this connection, the author repeated a paragraph of the Paper which, he thought, explained fully the manner in which inclusions should be viewed: "Remarks on inclusion types should be looked upon only as trends that may exist, for the other factors that are discussed in the Paper require greater consideration. The use of a certain type of deoxidiser is not going to make the steel relatively resistant to hot tearing."

(6) The widest practical range of pouring temperatures gave no indication that the casting temperature had anything to do with the formation of this particular hot tear.—*Comment*: Experiments in the United States with respect to the fittings showed that this was not the case, and that the degree of tearing was affected considerably. However, hot tearing was not prevented by changing the temperature of the metal as poured.

(7) Different moulding media and hardness of ramming were tried without any results.—*Comment*: This differs from experience in the United States. While the particular hot tears in question were not eliminated by changing sand conditions, the degree of tearing was changed materially.

Origin of Tears

It was noted that the British foundry attributed the reason for the hot tears to "insufficient fluid heat of metal at the moment of solidification." First of all, the degree of fluidity of the steel has nothing to do with hot tear formation. A steel cannot tear until it is solid. A lack of a supply of steel for feeding purposes may be responsible for the tear, as was shown in the Paper; however, it was found in America, in the particular case in question, that a well fed section can exhibit tears. It is also true that lack of feeding of the section aggravates hot tearing. Thus, I do not believe that the reason assigned was the correct one for explaining the hot tearing.

Valve manufacturers in the United States have had some little trouble with hot tears underneath the flanges in the ports of fittings. Many experiments have been carried on to study the influence of variations in core sand mixtures, the influence of heading and gating, and the influence of variations in ratio of flange thickness to wall thickness. It was found that by the use of certain sands a more pronounced hot tear could be found. The section could be completely fed, but hot tears still persisted even though the tears were more pronounced when the sections were not completely fed. Also, the greater the ratio of flange thickness to wall thickness, the greater is the tendency towards hot tearing. The tearing was prevented by the use of external chilling on the port area and at the fillet area back of the flange.

It will be noted that, again, little was implied and nothing said by the British foundry regarding the stresses involved during the cooling of the casting. First, in the cooling of the flange and wall area, a pronounced hot spot will exist at the location shown in the drawing, because of the location of the fillet and the core and their effect upon the rate of heat extraction. The hot spot area will exhibit the lowest strength of a cooling section.

The design of the casting is such that the light wall section completes solidification and begins to contract before the much heavier flange section. Stresses are

set up and tearing takes place in the weakest section in much the same way as was illustrated in Figs. 6 and 7 of the Paper. The sand mould assists in the tearing because it resists the normal contraction of the casting.

Responsibility of Design

Forget the drawing (Fig. A) and look at the casting. It is completely circular, both the flange and the wall, and hence is a stress-active system. Thus the design is responsible. This can easily be seen when it is realised, as shown by experimentation, that the greater the ratio of flange thickness to wall thickness, the greater is the tendency to hot tearing. The tear breaks into the port area rather than into the fillet because the stress is due more to casting design and less to mould resistance. Why is it that chilling the port area and the fillets is the practical remedy? The chills reduce the effect of the hot spot and increase the strength of the steel, since the steel at this point is at a lower temperature and hence stronger and more able to resist the concentration of stresses.

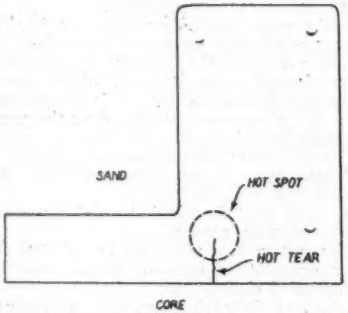

FIG. A.

It is noted that Mr. Fassotte pointed out that resistance to contraction due to casting design and nature of moulding materials is beyond calculation. While this is true, the author believed such statements tend to make foundrymen look upon the study of stress conditions, their origin and effect, as academic and of no practical value. He was firmly convinced that if a foundryman would review the reasons for stress formation and concentration, he would find the cause of hot tearing.—This is a much more direct method than attempting to track down the contributing variables such as was done by the British foundry in the investigation.

The author wished to thank Dr. Dadswell, Mr. Salmon, Mr. Cooper, Mr. Rowe and Mr. Skidmore for their contributions to the discussion of the Paper. He agrees with Dr. Dadswell in that steelmaking is a very important part of the hot tear problem. The proper type of inclusions should be obtained, and phosphorus and sulphur should be kept to a low figure. The writer wishes to take exception to the statement by Mr. Salmon, that the Paper "provided an excellent summary of the published information on hot tear formation." The Paper contains much original information, and it is the first time that all the variables have been tied together to show their relative importance.

A Test of Hot Tear Susceptibility

In reply to Mr. Salmon's question regarding the developments of a foundry test for hot tear susceptibility, it may be said that several foundry organisations and one research laboratory in the United States are working on such a test. One test has been developed, as reported by Crafts in Reference 14 of the Paper. It is noted that Mr. Salmon desires this test to show the influence of three variables: (1) Casting temperature; (2) steel composition and method of manufacture and (3) sand strength. The writer agrees with Mr. Salmon that for any given design of casting there is an "ideal range" of pouring temperatures; however, the temperature of the molten steel has no effect upon hot tear formation, except only in the variation of temperature gradients that can be formed in the metal and in the mould when the metal is in the mould. The use of superheated steel has no effect upon the properties of the steel at temperatures directly below its solidification temperature.

Further, in reply to Mr. Salmon, high sulphur content steels will not hot tear if the stresses acting on the casting are not sufficient to cause hot tearing. It can be said of two steel castings, one of high sulphur content and one of low sulphur content under identical contraction stresses, that the higher sulphur content steel will be more susceptible to hot tear formation than will the other steel. In this case hot tear formation will depend upon whether or not the stress exceeds the mechanical properties. There is no technical information available, to the knowledge of the writer, which shows that silicon or copper in substantial percentages in steel increase the mechanical properties of the steel at elevated temperatures, over that found for carbon steels.

In reply to Mr. Rowe, who was of the opinion that not enough emphasis was placed on the influence of steelmaking on hot-tear formation, the following question is proposed: In what manner can the manufacture of steel possibly affect the elevated temperature properties of the metal? There are only two ways: (1) inclusion type and distribution, and (2) gas (hydrogen or nitrogen) content.

Poor Steel No Criterion

A discussion of inclusion type and distribution was presented in the Paper. The writer did not go into the details of steelmaking methods for producing the proper inclusion types or their distribution, as the subject was hardly the subject of the Paper. The gas content of the metal does affect the conditions of porosity, and it is known that hot tears often originate

Hot Tear Formation in Steel Castings

out of cavities such as shrinkage cavities, as was illustrated in the Paper. Again the writer feels that it is necessary to add that the poorest made steel will not hot tear if it is not subject to high stresses at temperatures just below the solidification temperature of the steel.

The writer disagrees with Mr. Cooper and Mr. Skidmore, that the majority of hot tears are caused by carelessness. It is believed that the responsibility of most hot tears should be placed on: (1) the designer, and (2) the foundry layout committee, for not recognising the conditions accountable for stress formation at the hot tearing temperatures and taking the necessary steps to correct these conditions during the preparation of the pattern and the moulding of the casting.

In further reply to Mr. Skidmore's questions, it is believed that hot tears form at the time of, or after, completion of solidification of a section. The writer recognises no "stiff pasty state" in the progressive solidifications of a steel casting. Also, cavities do not cause hot tears to lead out of them since hot tears need not be associated with cavities at all. However, in some cases hot tears are found to be associated with cavities, such as internal hot tears resulting from solidification contraction.

The writes appreciates the complimentary remarks of Mr. Fassotte, Mr. Salmon and Mr. Faulkner, and is very much pleased that they found the Paper valuable and interesting. The writer regrets that he was unable to present the Paper in person, as he would very much have liked to meet those who took part in the discussion and others of the British steel castings industry. He greatly appreciated the opportunity of preparing the American Foundrymen's Exchange Paper to the Institute of British Foundrymen.

NEW CARNEGIE-ILLINOIS ELECTRIC FURNACE

A new electric furnace has been placed in operation at the South Chicago Works of Carnegie-Illinois Steel Corporation, and adds 65,000 tons annually to American capacity for the production of aircraft steels. The new furnace turns out 70 tons per heat of steel. Installation was begun in October, 1942, and completed early this month. The South Chicago Works made its first electric furnace steel in 1909, when a furnace having a capacity of 15 tons per heat was installed. This, together with another built in 1916 was dismantled in 1922. The present electric furnace department came into being in 1917 with the installation of two 25-ton furnaces. A third furnace was added in 1918. In October, 1941, in order to meet increasing demand for high-quality alloy steels for ordnance, aircraft and mechanised equipment, two new furnaces were placed in operation, more than doubling the plant's previous electric furnace capacity.

FOUNDRY FUEL CONSERVATION

As was to be expected, the fuel economy campaign has now reached America, and Mr. Jas. R. Allan, chairman of the A.F.A. Industrial Hygiene Codes Committee, has listed sixteen useful hints, which are as follow:—

(1) Do not add space-heating equipment if not absolutely necessary.

(2) Offices should not be heated above 72 deg. F.

(3) Factory areas, not including warehouses and storage spaces, should not be heated above 65 deg. F.

(4) Factory areas used for sedentary operations, such as inspection, etc., should not be heated over 70 deg. F.

(5) Wash and locker rooms should not be heated over 72 deg. F.

(6) Toilet rooms only should not be heated above 60 deg. F.

(7) Dining rooms, cafeterias and lunch rooms should not be heated above 72 deg. F.

(8) During non-working periods, such as nights, Saturdays, Sundays and holidays, buildings should not be heated above 40 deg. F. Be careful of sudden cold snaps that might cause piping in buildings to freeze at the lower temperatures.

(9) Make sure that boiler flues are kept clean so that maximum boiler efficiency is obtained. Be sure that drafts are correctly adjusted on boilers; that the fires are cleaned properly; and, where your coal is stored on the ground, be sure it is all picked up and used instead of leaving it scattered on the ground.

(10) Make sure there are no leaks in pipe lines or storage tanks where oil systems are used.

(11) Make sure all gas lines are tight to prevent leakage.

(12) Do not start fires in industrial furnaces too far ahead of the time needed.

(13) Do not reduce temperatures of industrial furnaces by operating a reducing flame condition. Reduce flow of fuel.

(14) Operate industrial furnace equipment at the proper temperature for the job. Do not overheat.

(15) Get the maximum fuel-to-metal charge ratio on all melting equipment such as cupolas, reverberatory furnaces, open-hearth furnaces, etc.

(16) Electric lights and electric power represent use of fuel. Therefore, particular attention should be paid to turning out lights, shutting off motors and electrical heating furnaces when not needed. Every kw.-hr. of electrical energy saved will save approximately 1½ lbs. of coal. When you have burned a 100-watt lamp for 10 hrs. you have used 1½ lbs. of coal.

The Workmen's Compensation Acts, 1925-1943. Tables of Weekly Compensation, as increased by The Workmen's Compensation (Temporary Increases) Act, 1943, by H. Morgan Hughes. Published by Stevens & Sons, Limited, 119 and 120, Chancery Lane, London, W.C.2. Price 3s. 6d. net. The title of this 12-page booklet indicates fairly clearly the ground covered. Tables for both total and partial incapactiy are included.

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clean iron, free from sand, free from sows ...uniform analysis... convenient size...easy handling... specify STANTON
MACHINE CAST PIG IRON

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WEIGHT	80-90 lbs.
Length	22 inches
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Thickness	3¾ inches

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Ample supplies direct from stock

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NEWS IN BRIEF

ALEXANDRA FURNACES, LIMITED, Cardiff, have changed the name of their company to Sklenar Patent Melting Furnaces, Limited.

THE ANNUAL MEETING of the Institute of Metals will be held at 4, Grosvenor Gardens, London, S.W.1, on March 15, at 11 a.m.

STRAND ENGINEERING WORKS, LIMITED, 104, Beverley Road, Hull, is paying a supplemental dividend of ¼d. in the £, payable February 5, at the Official Receiver's Office, 1, Parliament Street, Hull.

SIR HAROLD SPENCER JONES, F.R.S., the Astronomer Royal, has accepted the invitation to deliver this year's May lecture to the Institute of Metals. His subject will be "Metals in the Stars." The lecture will be delivered on May 17, in the hall of the Institution of Mechanical Engineers, London.

INDUSTRIAL CLOGS have been down-pointed from three to two coupons a pair. (Their distribution will be regulated by priority dockets.) A new type of wooden-soled industrial rubber boot, rated at four coupons a pair, has been included in the schedule. These boots may, however, be sold only against a buying permit.

WORK HAS BEGUN on the new project introduced to the Beardmore factory in Renfrewshire, according to the Regional Board for Scotland, Ministry of Production. Another Renfrewshire factory affected by programme changes will have two production units, while other projects will be directed to premises in Glasgow and Renfrewshire.

THE NATIONAL ARBITRATION TRIBUNAL have rejected a claim for premium day rate pay on Bank Holiday Tuesday, last year, made by members of the Sheffield Amalgamated Union of File Traders against Thomas Firth & John Brown, Limited, Sheffield. The firm's case was that, through an oversight, the men's union had not been consulted regarding a change made to fit in with the holiday arrangements. They had, however, posted notices in all the workshops in good time.

LATIN AMERICAN nations will have a combined capacity for producing approximately 1,400,000 tons of steel ingots and castings upon completion of new plants now under construction, according to the American Iron and Steel Institute. Brazil and Mexico together will account for close to 85 per cent. of the total Latin American steel industry. Plants in Peru, Argentine, Chile and Colombia together will represent a little more than 15 per cent.

THE NATIONAL ASSOCIATION of Bolt and Nut Stockholders was constituted two or three months ago, and is at present in the preliminary stages of organisation. At the moment it comprises some 83 founder members. Although the Association initially will be concerned with questions affecting the distributive trade in bolts and nuts, it will deal with all questions affecting articles coming under the Control of Bolts and Nuts, Screws, Screw Studs, Washers and Rivets Order, with the exception of wood screws, safety socket screws, Parker Kalon screws and aircraft bolts, nuts, screws and rivets.

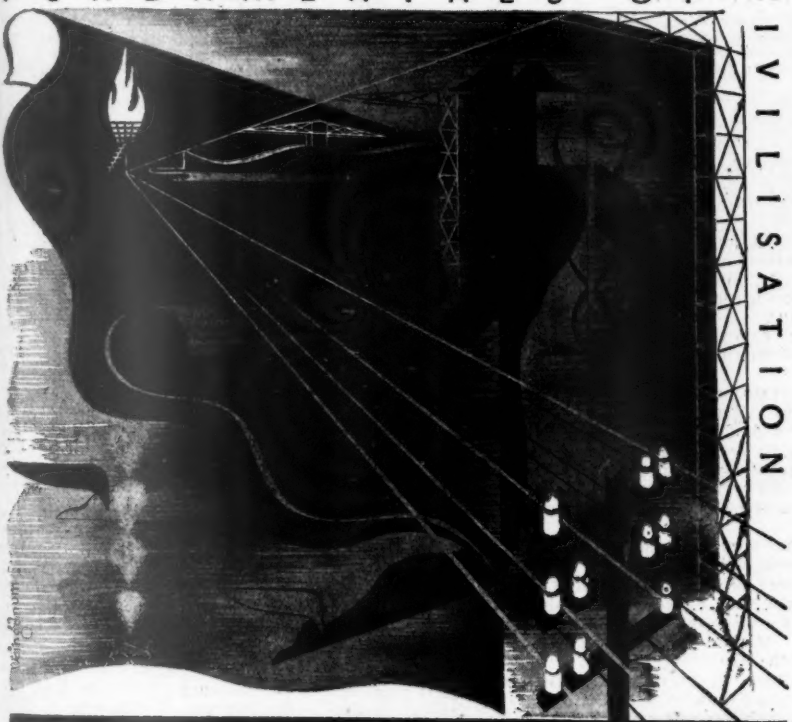
GODWIN, WARREN & COMPANY, LIMITED, iron and steel stockholders and merchants, of Bristol, made presentations on Saturday, January 22, to three members of their staff who have recently completed 50 years' service. They are Mr. W. P. Jarrett, senior member of the office staff; Mr. H. E. Blake, formerly Bristol representative and now cashier; and Mr. F. Dwelly, representative in the South and West of England. At the ceremony there were present five other members of the staff, all of whom have succeeded their fathers in the employ of Godwin, Warren & Company. The firm has been in existence for over 120 years.

AMERICAN STEEL PRODUCTION RECORDS were broken in October when total output reached 7,786,359 tons of ingots and steel castings, despite some loss in production caused by the coal strikes, states the American Iron and Steel Institute. The October total exceeded by more than 100,000 tons the previous peak of 7,670,187 tons established in March, 1943, largely because of new steel furnaces which have been put into operation since March. By an even wider margin the October total exceeded the peak 1942 production of 7,579,514 tons in one month. In September, 1943, a total of 7,488,978 tons was produced. During the month of October, the steel industry operated at an average of 100.8 per cent. of capacity—the highest monthly rate of operations yet achieved in the war period.

THE DIRECTORS of the Newall Engineering Company, Limited, Peterborough, propose to reorganise the capital to facilitate the future development of the business and obtain immediate subscription of additional capital to the extent of £80,000 in new 6 per cent. cumulative preference £1 shares. This issue, it is stated, has been sanctioned by the Treasury. The present authorised capital is £190,000—£60,000 in 6 per cent. cumulative redeemable £1 preference shares, £80,000 in 5s. "A" ordinary, and £50,000 in 2s. "B" ordinary shares. It is proposed to redeem the 6 per cent. redeemable preference at 21s. 6d. per share, and to increase the authorised capital to £400,000, comprising £150,000 in 6 per cent. cumulative £1 preference, £150,000 in 7 per cent. non-cumulative £1 preferred ordinary, and £100,000 in 2s. ordinary shares.

LORD SELBORNE, Minister of Economic Warfare, stated last week that there were ships lying in ports of the Bay of Biscay with machine tools, prototypes of aircraft, tanks, etc., and special components, all of which were greatly needed by Japan. The anti-aircraft guns which were protecting them had not prevented Allied bombing attacks, and already two vessels had been so badly hit that they had been unable to sail. The others feared to take the plunge. Cargoes which Germany had been trying to obtain from Japan included tin and tungsten. During the last blockade-running season, she lost three-quarters of what she attempted to get in. Every week the blockade was drawing tighter. It was a slow instrument in starting, but was now playing an increasingly important part. Germany was finding it more and more difficult to obtain goods from outside, even from contiguous neutral countries.

FUNDAMENTALS OF CIVILISATION



THE UNITED STEEL COMPANIES LTD

No. 7 COMMUNICATION AT A DISTANCE

Mercury of ancient mythology was the courier of the gods flying with winged sandals to transmit their will to men.

In the dim past, tribe spoke to tribe by means of smoke signals. Then came the flaring beacons—those flames on Skiddaw which " roused the burghers of Carlisle." In days of dire peril the news of Napoleon was flashed along the coasts by semaphore.

The invention of the telegraph, telephone and radio has quickened communication between the nations of the world.

Civilisation extends through the propagation of experience, information and ideas to far distant lands. A vital part in all these complex methods of communication is played by steel.

THE UNITED STEEL COMPANIES LIMITED

STEEL, PEECH & TOZER, SHEFFIELD
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UNITED COKE & CHEMICALS CO. LTD.
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U.S.P. 31

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

558,055 CLARE, C. H. Chucks for drills, reamers, milling cutters and like tools.

558,060 KENILWORTH MANUFACTURING COMPANY, LIMITED, and LUCKETT, F. H. Manufacture of leakproof flanged joints.

558,072 BUDD MANUFACTURING COMPANY, E. G. Welding apparatus.

558,074 LUMB, C. F. Production of hard, corrosion resistant alloy surfaces on metal articles.

558,085 INSHAW, G. R. Pipe joints and the like.

558,089 BUDD MANUFACTURING COMPANY, E. G. Welding Apparatus.

558,094 BIRMINGHAM ELECTRIC FURNACES, LIMITED, and HARRIS, J. Furnaces for the heat-treatment of metals.

558,097 BUNYAN, J., TAYLOR, C. A., and RAWLPLUG COMPANY, LIMITED. Securing of rails or the like to railway sleepers or like surface.

558,107 DU PONT DE NEMOURS & COMPANY, LIMITED, E. I. Manufacture of metallic powders.

558,110 BIRMINGHAM ELECTRIC FURNACES, LIMITED, and HARRIS, J. Furnaces for the heat-treatment of metals.

558,118 BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Electromagnetic switches.

558,123 ARON, H. Forging and shaping metals.

558,130 CROWN CORK & SEAL COMPANY, INC. Method of and apparatus for electroplating sheet metal.

558,133 SIMONS, A. Method of producing metal strips, sheets and the like.

558,139 RANSOMES, SIMS & JEFFERIES, LIMITED, RANSOME, D. P., and CLARK, A. H. Control gear for electric trucks, vehicles and cranes.

558,146 EVERY, C. E. (Titanium Alloy Manufacturing Company). Iron alloys or steels.

558,158 ASQUITH, LIMITED, W., BURNESS, T. P. N., and JOHNSON, A. Combined spirit level and micrometer control for grinding and other machine tools.

558,176 LOEWY ENGINEERING COMPANY, LIMITED, and WUTSCHER, T. Rotary stamping machine for rolled material.

558,178 BROOM & WADE, LIMITED, and BROOM, H. S. Pneumatic motors.

558,181 BRITISH ROPEWAY ENGINEERING COMPANY, LIMITED, SHIELDS, H. F. H., and GROSSMITH, G. W. Apparatus for loading and unloading wheeled vehicles.

558,182 BRITISH PISTON RING COMPANY, LIMITED, TWIGGER, T. R., and JUDD, J. A. Manufacture of metal inserts.

558,190 TROSTLER, F., ANDREWS, T., and HUNTINGTON, HEBERLEIN & COMPANY, LIMITED. Separation of solid materials of different specific gravities.

PERSONAL

MR. DONALD J. W. ORR has been elected a director of the Imperial Smelting Corporation, Limited.

MAJOR THE HON. O. M. GUEST, M.P., has accepted the presidency for next year of the Institution of Production Engineers in Wales, in succession to Mr. A. Bailey.

LT.-COL. JAMES F. HAMILTON HOULDSWORTH, J.P., vice-chairman of the Coltness Iron Company, Limited, has been made a Deputy Lieutenant of the County of Lanark.

MR. J. ROY PATON, managing director of Robert R. Paton, Limited, Cardiff, has been elected president of the Engineering and Allied Employers' South Wales Association.

MR. TREVOR CALVERT, of Stockton-on-Tees, a metallurgical chemist employed by the South Durham Steel & Iron Company, Limited, has been appointed chief technical assistant at the London Testing Works' chemical laboratory at Westminster.

MR. H. S. ROBINS has been appointed general manager of Francis Morton & Company, Limited, constructional engineers, of Garston, Liverpool. For the past five years Mr. Robins has been constructional manager to Palmers Hebburn Company, Limited.

MR. STANLEY ROBSON has been elected a director of the Imperial Smelting Corporation, Limited. In association with certain Australian interests, the Corporation are forming a research and development organisation of which Mr. Robson will become the director-general.

SIR WM. LAWRENCE BRAGG, F.R.S., Cavendish Professor of Experimental Physics, Cambridge, has been elected an honorary member of the Institute of Metals. He is president of the Institute of Physics, and gave the May lecture to the Institute of Metals in 1935, on "Atomic Arrangement in Metals and Alloys."

TWENTY-FOUR EMPLOYEES with a total service of over 900 years signed an illuminated address presented to Mr. William Gray, foundry manager, who has completed half a century with R. B. Tennent, Limited, Whifflet Foundry, Coatbridge. A presentation was also made to Mr. Hugh Loch, foreman patternmaker, who has celebrated his jubilee with the firm.

Wills

HALEY, C. H., managing director of William Barraclough, Limited, ironfounders, Leeds ... £30,631

BAYLEY, W. L., of Wednesbury, general manager of Guest, Keen & Nettlefolds, Limited, Darlaston ... £10,456

BISSELL, T., of Edgbaston, director of Crawley, Parsons & Company, Limited, metal merchants £20,955

HEMMINGS, J. W., of Sheffield, founder of Hemmings & Company, and a director of Sheffield Steel Products, Limited £5,149

NEGOTIATIONS have been completed for the acquisition by the British Rollmakers' Corporation, Limited, of the roll-making interests of Bayliss, Jones & Bayliss, Limited, and John Lysaght, Limited.

NO. 10 PREPARED BLACKING

● The Latest Core and Mould Wash for IRON CASTINGS

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STEELMOL

for STEEL and SPECIAL IRON CASTINGS

HIGH CARBON BLACKING
CEYLON PLUMBAGO
TERRA FLAKE · COAL DUST · GANISTER AND ALL FOUNDRY SUPPLIES

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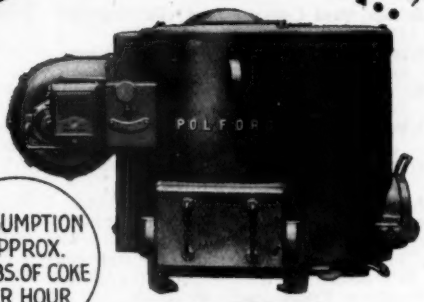

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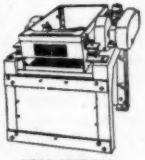
...THE MOST *Economical Dryer*

CRUCIBLE FURNACE

Designed for the drying of moulds in the floor or *in situ*, the "Polford" Portable Mould Dryer is definitely the most economical dryer of its kind. Strongly built and lined throughout with a special monolithic lining, ensuring long life and freedom from all lining trouble. Other special features are—Uniformity of Drying and Complete Control of Temperature. Self-contained and Adaptable.

Can be adapted to stoves.



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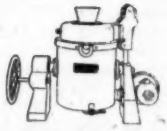
"POLFORD" *Portable* MOULD DRYER

CORE SAND MIXER



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Other "POLFORD" Products

THE HEATON FOUNDRY CO. LTD.

Makers of Foundry Equipment,

HEATON JUNCTION, NEWCASTLE UPON TYNE, 6

COMPANY RESULTS

(Figures for previous year in brackets)

Head, Wrightson—Interim dividend of 2½% (same).

United Gas Industries—Interim dividend of 5% (same).

British Steel Constructions (Birmingham)—Dividend of 15% (7½%).

Greenwood & Batley—Interim dividend of 5% on the ordinary shares (same).

R. A. Lister—Final dividend of 5% and a bonus of 6% (same), making 16% (same).

Kitchen & Wade—Bonus on the ordinary shares of 5% (same), making 30% (same) for the year to March 31, 1943, and a second interim of 12½% for the year to March, 1944 (same).

J. & E. Hall—Net profit for the year to September 30 last, £95,036 (£84,429), after making provision for E.P.T. £140,000 (£100,000), but before charging for income-tax £55,000 (£27,000); ordinary dividend of 10% (same); forward, £63,104 (£49,068).

Weyburn Engineering—Profit to October 31 last, after depreciation and E.P.T., £34,005 (£31,683); income-tax, £17,500 (£13,100); general reserve, £5,000 (same); final dividend of 22½% (same), plus bonus of 5% (same), making 35% (same); forward, £2,035 (£2,829).

Ley's Foundries & Engineering—Net profit, after tax, £43,666 (£39,121); preference dividend, £11,250 (same); interim ordinary dividend of 6%, £16,500 (same); final dividend of 5% (same), £13,750; forward, £48,889 (£46,723). The consolidated accounts show a net profit for the group of £76,561 (£61,158).

OBITUARY

MR. JOHN MARSHALL, who died suddenly at Clydebank, had been since 1940 secretary to the Singer Manufacturing Company, Limited. He had been with the company for almost 25 years. Mr. Marshall, who was 55, was a native of Glasgow.

MR. CHARLES EDWIN CARY, governing director of William E. Cary, Limited, spring makers and iron and steel stockholders, died at Manchester on January 20. He was a well-known figure in the Manchester steel trade, and an authority on laminated springs.

MR. JOHN HENRY LLOYD died recently at his home at Edgbaston, Birmingham, aged 88. He began his business career with Tangye Bros., engineers, of Birmingham, in 1877, but in the following year became a partner in the family business of Lloyd & Lloyd, tube manufacturers. Later he became chairman of the concern, which eventually amalgamated with Stewart & Menzies, under the style of Stewarts and Lloyds, Limited. He was a director of this company from 1903 to 1931. Mr. Lloyd had served on the Birmingham City Council for 53 years. He became Lord Mayor in 1901, and in the same year was elected an Alderman. The Honorary Freedom of the city was conferred on him in 1932. Mr. Lloyd was a member of the London Committee of Stewarts and Lloyds of South Africa, Limited.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Albert E. Edwards (Engineers), Dalmeny Street, Liverpool, 17—£1,000. A. E. and M. I. Edwards.

Barnes Engineering Company, 8, Deans Road, Bournemouth—£10,000. G., E. M., and J. D. Barnes.

James & Henry Wood, 251a, Monument Road, Birmingham—Engineers, machine tool specialists, etc. £2,000.

Salamandre Metal Works, 90, Charlotte Street, London, W.1—£1,000. G. L. Debaisieux, J. Roth, and L. L. H. Corteen.

Lees Hall & Sons, 113, Whitehouse Common Road, Sutton Coldfield—Industrial furnace manufacturers. £3,000. I. Lees Hall, M., J. and E. Hall.

Ford & Company (South Shields), Middle Gate Entrance, Tyne Dock, South Shields—Metallic packing manufacturers. £5,000. W. J. and R. Ford, and J. G. Younger.

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"JAC"—Locking washers. GUEST KEEN & NETTLEFOLDS, LIMITED, London Works, Smethwick.

CRANE IN FLIGHT (device)—Cranes, hoists and lifts. J. & H. LOWE (CRANES), LIMITED, Cowhill, Oldham.

"SIMPEM"—Electrode holders. CAMMELL LAIRD & COMPANY, LIMITED, New Chester Road, Birkenhead.

"AGATEX"—Screening and sifting machines, etc. N. GREENING & SONS, LIMITED, Britannia Works, Bewsey Road, Warrington.

SWAN (device)—Wire ropes. GARNOCK, BIBBY & COMPANY, LIMITED, Old Swan Rope Works, St. Oswald's Street, Liverpool, 13.

"CYGNET"—Wire ropes. GARNOCK, BIBBY & COMPANY, LIMITED, Old Swan Rope Works, St. Oswald's Street, Liverpool, 13.

CONTRACTS OPEN

Any date given is the latest on which tenders will be accepted. The address is that from which tender forms may be obtained.

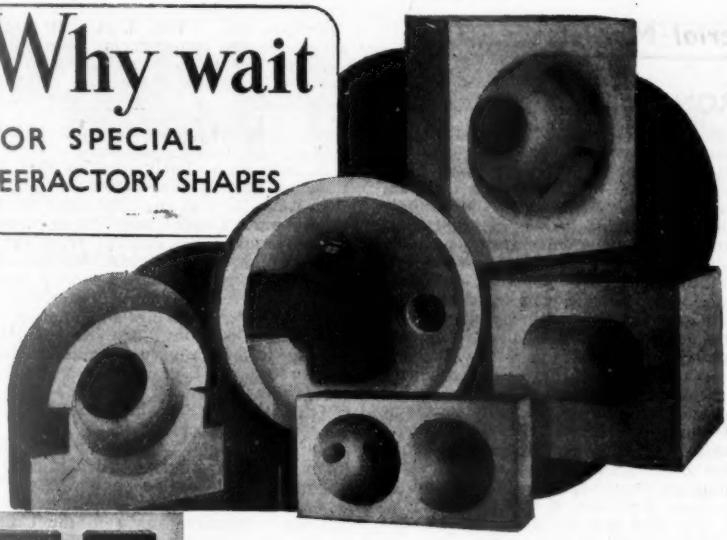
Belfast, February 9—Iron castings, tyres and axles, springs, bolts, spikes, nails, screws, files, etc., for the Belfast and County Down Railway Company. Mr. T. B. Andison, secretary, Queen's Quay Terminus, Belfast. (Fee 1s.)

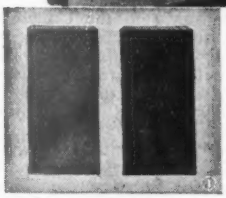
Beverley, February 7—Provision, laying and jointing of 4,900 yds. of 4-in. and 5-in. spun-iron water mains, together with valves, etc., for the Rural District Council. Mr. G. Palfreyman, engineer and surveyor, 36, Market Place, Beverley. (Fee £1 1s., returnable.)

Oswaldtwistle, February 14—Cast-iron pipes and special castings, for the Urban District Council. The Surveyor.

Why wait

FOR SPECIAL
REFRACTORY SHAPES





NO SHRINKAGE. Illustration (1) shows two blocks cast in moulds and dried at atmospheric temperature. One was fired to 1500° C for four hours. Specimens are the same size.

STRENGTH. Illustration (2) shows two test pieces cast in moulds, dried at atmospheric temperature and one heated to 1000° C. Tensile strength —*Unfired*, 550 lbs. per sq. in. *Fired*, 1312 lbs. per sq. in.

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Raw Material Markets

IRON AND STEEL

Steelworks and foundries are amply provided with pig-iron. Substantial reserves of basic iron for steel-making and of common foundry iron have been accumulated. Production of low- and medium-phosphorus iron, which was formerly in short supply, has overtaken the demand, and makers of refined iron are supplying increased tonnages to various establishments in place of hematite. The Control is still very sparing with its allocations of hematite, and will authorise deliveries only when it can be shown that no other grade of iron can be used in its place.

Activity in the engineering and allied foundries seems to have passed its zenith, and, as the slackness in the light-castings trade persists, the call for pig-iron, hematite excepted, imposes no special strain on the producers. The scrap situation is gradually becoming tighter, and the Control is encouraging foundries to use more pig-iron by cutting down allocations of cast-iron scrap. Coke is in good supply, and limestone also is forthcoming as required. The increase in the price of coal as from February 1 will mean higher costs to the iron and steel manufacturers, but whether it will be reflected in prices remains to be seen.

The demand for re-rolled products is quite exceptional. Execution of orders in hand will involve maximum production for several months ahead. There are ample supplies of semis in sight. At most of the works good stocks have been accumulated. Weekly deliveries from the steelworks are on a satisfactory scale, and substantial tonnages of defective billets, crops, etc., are also being used in re-rolling. Although the plate mills are operating under extreme pressure, the regular provision of supplies to the shipyards is a paramount consideration. This responsibility is being faithfully discharged, and very considerable tonnages are also on the list of orders from boiler-makers, engineers, and other vital war industries. There is less scope for the execution of further orders for light sections than for the heavier sizes. Collieries are taking up their maximum quotas of rails, roofing materials, etc. The sheet mills are not at present taking on new commitments of any magnitude, simply because they are so heavily booked; much the same conditions prevail in the wire and rivet trades.

NON-FERROUS METALS

It now seems fairly obvious that the supply position, as regards non-ferrous metals, is much easier than it has been at any time since the first few months of the war. Copper supplies, in particular, appear to have overtaken the demand from the war industries. Consumption of this metal has passed its peak, both in this country and in the United States. Although no civilian releases have been made here, important commercial undertakings in America are being given increased allocations. The American consumption of copper during January is believed to have been the lowest for over a year, but a considerable increase is forecast for February.

The Colonial Office has announced that purchase of copper from Northern Rhodesia will be reduced by about 25 per cent. This cut will be borne equally by Roan Antelope, Rokana and Mufulira; the increase in output planned for Nchanga will not be made. Tin is in reasonably good supply considering that Far Eastern production is lost to the United Nations. It is not yet known to what extent relations between the Allies and Bolivia will affect the situation. At present, the United Nations are the only market for Bolivian tin, and as it is by the mines that Bolivia lives, it is not likely that she will withhold supplies; without the support of the United States the country is threatened with economic collapse. Zinc is in easier supply, and manufacture of galvanised products is increasing. Lead has not followed the trend displayed by some of the other non-ferrous metals, but the position should improve now that the shipping situation allows more imports to be made.

BY NEXT MAY, the well-known Lake City Malleable Company, of Cleveland, Ohio, will have at its disposal a second plant, costing $3,360,000, which is being erected at Ashtabula, Ohio.

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